Chemical Bonding and Reactions

PS-4 The student will demonstrate an understanding of chemical reactions and the classifications, structures, and properties of chemical compounds.

PS-4.4 Classify compounds as crystalline (containing ionic bonds) or molecular (containing covalent bonds) based on whether their outer electrons are transferred or shared
Taxonomy Level: 2.3-B Understand Conceptual Knowledge

Key Concepts:
Ionic crystals
Molecular substances

Previous/Future knowledge: In the 7th grade students translated chemical symbols and the chemical formulas of common substances to show the component parts of the substances (including NaCl [table salt], H_2O [water], $C_6H_{12}O_6$ [simple sugar], O_2 [oxygen gas], CO_2 [carbon dioxide], and N_2 [nitrogen gas]). (7-5.2)
In Physical Science students will expand their concepts of chemical compounds and elements by classifying the bonds as ionic or covalent and the combination as molecular or crystalline compounds.

It is essential for students to
Ionic Crystals
- Understand that ionic crystals consist of metals bonded to nonmetals.
  - In general when metals react with nonmetals, electrons are transferred from the metals to the nonmetals.
  - The metals form positive ions and the nonmetals form negative ions.
  - Positively charged metal ions attract negatively charged nonmetal ions.
  - These positive and negatively charged ions pack together as closely as possible in a crystal lattice to form an ionic crystal.
  - Examples of ionic crystals may include: sodium chloride (NaCl), sodium hydroxide (NaOH), calcium fluoride (CaF_2), and potassium iodide (KI).

Molecular Substances
- Understand that molecular substances often consist of nonmetals.
  - When nonmetals form compounds with other nonmetals, they form covalent bonds.
  - Nonmetals will share electrons with each other to become stable.
  - Bonds formed by sharing electrons are covalent bonds.
  - Molecules are compounds that have covalent bonds.
  - Examples of molecular substances may include: hydrogen gas (H_2), carbon dioxide (CO_2), water (H_2O), and sugar ($C_6H_{12}O_6$).

It is not essential for students to
- Classify covalently bonded molecules other than combinations of nonmetals unless they are told that the electrons are shared;
- Understand percent ionic character.

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Assessment Guidelines:

The objective of this indicator is to *classify* compounds as crystalline or molecular based on the bonding, therefore, the primary focus of assessment should be to detect the features of ionic compounds or covalent molecules that would place those substances into a particular group.

In addition to classify, assessments may require that students

- *Exemplify* an ionic or covalent compound based on the type of bond;
- *Compare* ionic and covalent bonds, and also molecular and crystalline ionic compounds; or
- *Infer* that bonds are ionic or covalent.